

## **Examples of Emerging Technologies for the 21<sup>st</sup> Century**

It seems that the technological innovation that has been spurred to date by Clean Air Act requirements is just the tip of the iceberg. Hundreds of new products are under development, in testing, or coming into the market that will further help meet air quality requirements. The following list includes new and emerging technologies that can help to reduce air pollution emissions and may help achieve cleaner air for all Americans in the 21<sup>st</sup> Century.

### **1. Mobile Source**

#### **Fuel Cell and Electric and Electric Hybrid Vehicles**

*GM Fuel Cell Electric EV1*  
*GM Parallel Hybrid EV1, Series EV1*  
*Nissan Motor Corporation Altra EV*  
*DaimlerChrysler New Electric Car (NECAR) 4*  
*Solectria Corporation Solectria Sunrise*  
*Zevco Millennium Taxi*  
*Toyota FCEV*  
*Toyota eCom*  
*Toyota Prius Sedan*  
*Dodge Intrepid ESX2*  
*Robert Wright & Company ECE City Bus*  
*Chrysler Motor Corporation 1999 Electric Minivan (EPIC)*  
*TH!NK Nordic AS TH!NK (EV)*  
*Volvo Power Split Hybrid Research Car*  
*Honda Insight (hybrid electric)*

#### **Alternative Fuel Vehicles**

*GM CNG EV1*  
*Toyota Camry CNG*  
*Honda GX (Natural Gas)*  
*Ford Crown Victoria Dedicated NGV*  
*DaimlerChrysler 1999 NGV RAM Van/Wagon*  
*Ford Econoline Dedicated NGV*  
*Ford F-Series Dedicated NGV*  
*Warsitz Hydrogen Spirit*

#### **Hybrid Electric Buses and Trucks**

*Coval H2 Partners T-1000 Neighborhood Truck*  
*ISE Research Corporation ThunderVolt 701 and ThunderVolt 801-H (Heavy Duty Electric Trucks)*  
*Canadian Electric Vehicles Ltd Might-E-Truck*  
*Toyota Motor Corporation Coaster (Hybrid Bus)*

## **Alternative Fueled Trucks & Engines**

*Chevrolet/GMC Medium Duty Conventional Truck*  
*Mack Trucks E7G Natural Gas Series (LE and MR)*  
*GMC Sierra Bi-Fuel CNG Pickup*  
*PowerTech 8.1 L CNG Engines*  
*Fiba Canning CNG & LNG Industrial Heavy duty Vehicles*  
*John Deere 6081H Natural Gas*  
*Cummins C8.3 G and 10 G (CNG/LNG)*  
*Caterpillar 3176B, C-10, C-12 (CNG/Diesel dual fuel)*  
*Detroit Diesel Series 50G/60G Natural Gas*  
*Detroit Diesel Ethanol Series*

## **Cleaner Small Engines**

*eCycle Inc. eCycle (electric)*  
*Zap Bikes Electricycle(electric)*  
*Electric MotorBikes Inc. Lectra (electric)*  
*Corbin-Pacific, Inc. Sparrow P.T.M. (electric)*  
*Advanced Engine Technologies, Inc. OX2 Internal Combustion Engine*

## **Other Mobile Source Air Pollution Reduction Devices (all in R&D stage)**

### **FUELS**

*ELF Aquitaine Aquazole (Diesel fuel)*  
*TCPI, Inc Dr. Diesel™ (Diesel fuel additive)*  
*AG Environmental Products, L.L.C SoyGold Marine™ (Marine Fuel Additive)*  
*AG Environmental Products L.L.C SoyDiesel (diesel fuel additive)*

### **ENGINES**

*Toyota Motor Corporation Direct-Injection 4-Stroke Gasoline Engine*  
*Volvo Car Corporation Volvo Petrol Direct Injection*  
*Caterpillar Dual-Fuel Engines (CNG, LNG, Diesel)*  
*Honda ZLEV and Integrated Motor Assist*

### **CATALYSTS & OTHER POST COMBUSTION TECHNOLOGIES**

*Engelhard Corporation PdPLUS™ catalyst PTX Catalyst TriMax™ Catalyst*  
*Volvo Car Corporation Chemically Heated Catalyst*  
*National Renewable Energy Laboratory and Bentler Industries Variable Conductance Insulation (VCI) catalytic converter*  
*Siemens Automotive SINOx*  
*Volvo Car Corporation and Engelhard Corporation PremAir™ catalyst*  
*Johnson Matthey Cam Converter Technology (CCT™)*  
*Engelhard Corporation DPX Soot Filter & STX Diesel Soot Filter*  
*Engelhard Corporation CMX Converter Muffler*  
*National Renewable Energy Laboratory and Benteler Industries Vacuum-Insulated Variable Conductance Catalytic Converter*

### **OTHER**

*Volvo Car Corporation Integrated Starter Generator*  
*Engelhard Corporation: GPX Coatings (applied to internal combustion components to reduce emissions, improve fuel economy and increase power output)*

## **2. Stationary Source**

### **Renewable Resource Fuels & Energy**

#### **Biomass**

Hynol High Efficiency Biomass Fuel Production Process (currently in testing at the University of California Riverside)

*Syntroleum Corporation* The Syntroleum Process®

*BG Technologies LLC* BG Systems (biomass conversion system)

*Synergy Technologies Corporation* Syngen

*FLS miljo Group* Biomass-fired Boiler

#### **Solar**

*Solar Energy Limited* Hydro Air Renewable Power Systems (HARPS)

*BP Solar* EUCLIDES™ Concentrator

*BP Solar* APOLLO® Thin Films

*BP Solar* LGBG Mono-Crystalline Modules

*Green Mountain Solar* sm Polycrystalline Modules

*SunLab* Solar Two

*UNI-SOLAR* Electric Modules

*Siemens Solar Industries* Copper Indium DiSelenide (CIS) thin film modules

#### **Wind Power**

*Southwest Windpower* AIR wind module

*Advanced Wind Power, Inc.* AWT-26

*New World Power Technology* North Wind 250

*Zond Systems* Z-40

#### **Energy Reduction Devices**

*AMCEC Inc* AMCEC ECOVAP (latent heat recovery process)

*Praxis Engineers, Inc* BANCS (control system)

*National Renewable Energy Laboratory (NREL)* Energy-10 (energy-efficient software for new buildings)

*Praxis Engineers, Inc* PECOS™ & SCYCLOPS™ (plant optimization software)

*Power Integrations, Inc.* TinySwitch Integrated Circuit (electrical reduction chip)

*Syntha Corporation* Syntha 2000 (plant optimization software)

### **Stationary Fuel Cells**

*Energy Research Corporation* Direct Fuel Cell (DFC)

*Zevco* Alkaline Fuel Cell

*BCS Technology* Forced-Flow PEM Fuel Cell

*H Power Corporation* EPAC™, PowerPEM®-D35, PowerPEM®-PS250, PowerPEM®-RW35, PowerPEM®-SSG50

*Energy Partners* NG2000

*Ceramic Fuel Cells Ltd.* Ceramic Fuel Cell

*Global Thermoelectric R & D* Solid Oxide Fuel Cell

*Warsitz* WFC 25 and WFC 50 Series High Performance Fuel Cells

### **Catalysts**

## **General Catalysts**

### **CO/VOC**

*Goal Line Environmental Technologies LLC ADCAT™ CO Oxidation Catalyst*  
*Johnson Matthey DualOx™ Catalyst*  
*Engelhard GEN™ diesel oxidation catalyst*  
*MIRATECH Corporation Oxidation Catalyst*  
*Glenro Catalytic Fume Oxidizer (used in hot air drying ovens. )*  
*Prototech Company PRO\*PEL-VOC pellets*  
*Prototech Company PRO\*BROIL™ catalyst (restaurant applications)*  
*Engelhard Corporation CharCat900 Catalyst (restaurant applications)*  
*Smith Environmental Corporation Catalytic Oxidizers, Direct-Fired Oxidizers, Smith PTO™ system*  
*Goal Line Environmental Technologies SCOVox*

### **NOx**

*Detroit Stoker Company METHANE de-NOx™*  
*Johnson Matthey SCR Catalyst*  
*Engelhard VNX™ Catalyst*  
*Catalytica Combustion Systems XONON™ Combustion System*  
*Catalytic Combustion Corporation Monolith Catalysts*

### **Other**

*Casso-Solar Gas Catalytic Heaters (used in Infrared (IR) heating systems)*

### **Regenerative Catalytic Oxidizers**

*Huntington Environmental Systems Econ-Abator® Regenerative Catalytic Oxydizers & Econ-Nox™ Catalysts*  
*Huntington Environmental Systems HES/RCO*  
*Johnson Matthey RCO Catalyst*  
*Goal Line Environmental Technologies SCONox™ Catalyst System*

### **Regenerative Thermal Oxidizers**

*Huntington Environmental Systems HES/RTO*  
*Adwest Technologies, Inc RETOX® Regenerative Thermal Oxidizers*  
*Durr Environmental, Inc Reeco RE-THERM® RL*  
*Durr Environmental, Inc TAR Recuperative Thermal Oxidizer*  
*Durr Environmental, Inc Ecopure® – Recuperative Thermal Oxidizer*  
*Smith Environmental Corporation Smith RTO/TCO*  
*Smith Thermal Recuperative Oxidizer SCO*

### **Ozone Destroying Catalyst**

*Volvo Corporation & Engelhard Corporation Premair*

## **Ultra Low-NOx Gas Fired Burners**

*Bloom Engineering Co Gemini Ultra<sup>2</sup> Low NOx Burner Series*  
*Combustion Tec Throughport Fishtail Burner & Inline Burner Firing*  
*Combustion Tec Oxygen Enriched Air Staging*  
*Coen Company Distributed Air Flow (DAF) Low NOx Burner*  
*Clayton Industries Low NOx/CO Steam Generators*  
*Coen Company Quantum Low NOx (QLN) burner*  
*John Zink Company Cool Fuel (low NOx burner retrofit)*  
*Detroit Stoker Company DETROIT® DB Low NOx Burner*  
*Dyson Hotwork Limited Low NOx Regenerative Burner*  
*Energy and Environmental Research Corporation FlamemastEER &EER Reburn Process*

*FLS miljo Group Benson-Type Power Station Boiler*  
*Radian International Radian Rapid Mix Burner (RMB)*  
*Parker Boiler Company Premix Metal Fiber Burner*

## **Coating Technologies**

### **Low VOC primers & coatings**

*United Coatings ACRYLEX 300 acrylic metal primer, and Primer 707 wood primer*  
*American Formulating and Manufacturing low VOC interior and exterior primer*  
*American Formulating and Manufacturing Safecoat Enamels*  
*Benjamin Moore & Co. Eco Spec Interior Latex Flat 219 Semi-Gloss 224*  
*United Coatings Interior and Exterior flat paints and roof coating*  
*Madison Chemical Industries, Inc. Madison Alumizinc 2000™ (primer/coating on tanks)*  
*Madison Chemical Industries, Inc. Madison Corropipe II TX-15 pipe coating*

### **Zero VOC primers & coatings**

*Evans Manufacturing, Inc Evans Peel Coat, Type I, II, III & IV coatings*  
*Silvertown Products, Inc. Wood Defense wood finish*  
*NonToxiCA Inc. Interior Flat Paint Series 100-I, and interior satin Series 200-I paint*  
*Spectra-Tone® Paint Corporation Spectra-Tone® Enviro Interior Enamel (8800) & Semigloss (9900)*  
*Vianova RESYDROL® Emulsions coatings, high gloss enamels, and wood stains and varnishes*  
*Electrostatic Technology, Inc. ETI Powder Coating System*  
*Madison Chemical Industries, Inc Madison Corrocote II PW™ water pipe sealer*  
*Madison Chemical Industries, Inc Madison Corrocote II Plus™ underground tank sealer*  
*Madison Chemical Industries, Inc Madison Marithane II Multi marine coating*

### **Material Application Technologies**

*American Turbine, Inc. HVLP AT-Series*  
*Lemmer Spray Systems Ltd. Lemmer T-55 HVLP*  
*The Better Paint Tray LLC*  
*Nordson Corporation Centuty® Selective Conformal Coating System*

## **Solvent-Free Adhesives and Cleaners**

### **Low VOC Metal and General Cleaners**

*Durr Environmental KFA (carbon fiber adsorption)*  
*Detrex Corporation Modular Detrex batch cleaning system*  
*Epcon® Industrial Systems, Inc. Epcon® Deoilers*  
*Micro Care Corporation ExPoxy™ Remover*  
*PCI of America HURRISAFE brake cleaners, carburetor, high pressure degreasers*  
*Sulzer Metco Plasma Spray*  
*Micell Technologies Inc. Miclean™ degreaser*  
*PCI of America HURRISAFE 9000 series (general cleaners)*  
*CRC Industries HydroForce™ Butyl-Free All Purpose Cleaner*  
*Micro Care Corporation VeriClean Flux Remover*

**Zero-VOC Metal & Parts Cleaners**

*NW Technologies, Inc* PC Series

*Oakite Products, Inc* Oakite® Gardoclean A5502

*RotoJet of America Co.,* Roto-Jet Spray Washing Cabinet

*ChemFree™ Corporation* ChemFree SmartWasher®, SmartWasher® Supersink

*Detrex Corporation* Detrex Series rotating basket washer and spray jet parts washer

*Kleer-Flo Company* Greaseoff™ multi-metal cleaner

*CAE Alpheus Inc* CO<sub>2</sub> MiniBlast™ Model SDI-5

*Drumbeaters of America, Inc* Cryo-Cleaner® System

**Zero-VOC Electronic Parts Cleaners**

*Micro Care Corporation* OS-20 Precision Cleaner

*Smart Sonic Corporation* SmarTsonic® Model 2000 & Model 4200

**Other Solvent Related Technologies**

*TransGlobal Environmental Products* TranSolv Technology (recycles industrial solvent waste)

*John Zink Series 2000™* Vapor Combustion System

*AMCEC Inc* Solvent Recovery Systems

*Baker Furnace, Inc* BIOTON® ( biological oxidation system )

*Geomembrane Technologies, Inc* Membrane Cover and Liner Systems

### **3. Other Cleaner Consumer Products**

**Lawn & Garden**

*Lawn-Boy* Electric Series of Lawnmowers

*Toro®* CareFree electric mowers

*Black & Decker* CMM1000 electric Lawnmower

*GrassMasters* LawnPup

*Ryobi Outdoor Products, Inc.* TrimmerPlus 1090r (electric trimmer)

**Clean Power & Fuels**

*United Solar Systems Corporation* Unipower USF-32, USF-11, USF-5 (portable solar battery chargers)

*Green Mountain Energy Resources* Solar<sup>sm</sup> Thin Films for rooftops

*Solarex* Millennia™ (rooftop solar cells)

*ACR Solar International, Inc.* Fireball 2001(solar water heater)

*Warsitz Enterprises, Inc.* HydroGrill™ (barbeque)

*Warsitz Enterprises, Inc.* RoamPower™ (portable Hydrogen power)